

## 1999 Paper 5 Question 2

### Computer Design

|                      |                           |         |                  |                        |
|----------------------|---------------------------|---------|------------------|------------------------|
| instruction<br>fetch | decode/<br>register fetch | execute | memory<br>access | register<br>write back |
|----------------------|---------------------------|---------|------------------|------------------------|

With reference to the classic RISC pipeline above, explain what a branch delay slot is and why it arises. [5 marks]

Demonstrate how conditional instructions can be used to avoid branches by writing code excerpts to perform the following function using a register-based processor. Comment your code to explain instruction semantics.

```
fun max(a,b) = if a>b then a else b; [5 marks]
```

To assist with subroutine calls, ARM processors have a branch-with-link instruction and Intel processors have a call instruction. How do these instructions differ from a simple branch? [5 marks]

What is an *interrupt* and how is it similar to a branch-with-link instruction on the ARM? [5 marks]